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Denis Fougère, CREST-INSEE and CEPR
Mathilde Poulhes, CREST-INSEE

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Centre for Economic Policy Research
77 Bastwick Street, London EC1V 3PZ, UK
Tel: (44 20) 7183 8801, Fax: (44 20) 7183 8820
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

The Effect of Housing on Portfolio Choice: A Reappraisal Using French Data*

Chetty and Szeidl (2012) propose to estimate the effect of housing on portfolio choice by distinguishing between the effect of mortgage debt and the effect of home equity and by endogenizing these two variables. When replicating their study with French data, we obtain similar qualitative results: an increase in mortgage debt (respectively, in home equity) reduces (respectively, raises) stockholding. However, while in the US the wealth effect of holding more home equity is cancelled out by the risk effect of owning a more expensive house, in France the wealth effect dominates the risk effect. We propose some explanations for this discrepancy.

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Denis Fougère
CREST-INSEE
15, Boulevard Gabriel Péri
92245 Malakoff Cedex
FRANCE

Email: denis.fougere@ensae.fr

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Mathilde Poulhes
CREST-INSEE
15 Boulevard Gabriel Peri
92245 Malakoff Cedex
FRANCE

Email: matilde.poulhes@ensae.fr

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www.cepr.org/pubs/new-dps/dplist.asp?authorid=176471

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1 Introduction

The influence of homeownership on financial investment decisions is a relevant issue for at least two reasons. First, because housing is often the most important asset in the household's portfolio composition. Second, because we know that the strategy of just adding housing to the vector of assets and then constructing the optimal portfolio by using a mean-variance efficiency framework is incorrect (Flavin and Yamashita, 2002). Housing is an investment good because capital gains or losses on housing affect the household's financial portfolio, especially when people move from one house to another. But housing is also a consumption good. So the choice of housing is not only determined by a portfolio maximization. Moreover, theory predicts that housing should generally lower demand for risky assets because, as an asset, housing is considered to be risky and illiquid.

The related literature is both theoretical and empirical. Most theoretical papers explain why housing lowers the demand for risky assets. For instance, Grossman and Laroque (1990) show that the illiquidity of housing drives the effect. For Flavin and Yamashita (2002), housing choice is overdetermined. They argue that the optimization of financial portfolio is constrained by the predetermined housing investment. They show that for many households, the constraint binds, so they hold less assets than the non-constrained optimization would have predicted. By contrast, empirical studies find no systematic relationship between housing and stockholding. Heaton and Lucas (2000) and Cocco (2005) estimate that the effect of housing property on stockholding is positive by using ordinary least squares (OLS). However, their finding is potentially biased since housing and stockholding result both from endogenous choices. The more shares the household owns, the more likely the household is to be rich and therefore to have an important housing wealth. Yamashita (2003) finds a more complex relationship: the proportion of stocks in financial portfolios exhibits a hump-shaped pattern against the house value to net worth ratio. In other words, when housing represents either a very small part or an important part of the total household wealth, household's stockholding is low.

In response to this controversy, Chetty and Szeidl (2012) set forth a framework that reconciles theory and evidence. They separate the effects of mortgage debt and home equity to characterize the effect of housing on portfolio choice. More precisely, Chetty and Szeidl (2012) derive an approximate expression for optimal portfolio shares from a theoretical stylized two-period model. This approximate expression takes the form of a linear regression model in which the household's stock share depends on housing property value and home equity. To tackle the endogeneity of these two regressors, they propose to use two instrumental variables (IVs), namely the average price of houses in the household's state in the year in which portfolios are measured and the average price of houses in the household's state in the year in which the house was bought. Using data for 60,000 U.S. households, they find that increases in mortgage debt reduce stockholding significantly, while increases in home equity wealth raise stockholding. Their estimates imply that a household with 10% more mortgage debt and home equity has a 3% lower portfolio share of stocks. They conclude that housing has substantial impacts on portfolio choice, as theory predicts.

Are the results obtained by Chetty and Szeidl still valid in the French case? To answer this question, we replicate their methodology by using a sample of approximately 2,000 households observed in the French "Patrimoine" survey conducted in 2010 by INSEE (Institut National de la Statistique et des Etudes Economiques, Paris). We estimate the same stock share equation by using the same econometric techniques (OLS, 2SLS, Tobit specifications) and the same instrumental variables as Chetty and Szeidl (2012). Our two IVs are the average home price per square meter in the household's corresponding French geographic area (*département*[1]) in the year in which portfolios are measured, i.e., 2009 Q4 ("date of the survey"), and the average home price per square meter in the household's corresponding French geographic area (*département*) in the year of the home purchase. Like in Chetty and Szeidl's study, these two instruments are found to be statistically valid. Moreover, we get similar qualitative results: an increase in mortgage debt (respectively, in home equity) reduces (respectively, raises) stockholding. However, while in the US the wealth effect of holding more home equity is cancelled out by the risk effect of owning a more expensive house, in France the wealth effect dominates the risk effect. In the last section, we propose some explanations for this discrepancy.

The paper is organized as follows. The next section presents the econometric methodology. Section 3 describes the data. Section 4 presents empirical results. Section 5 concludes.

2 Econometric methodology

The key implication of Chetty and Szeidl's model is that one must distinguish changes in property value from changes in home equity wealth to fully uncover the effects of housing on portfolio choice. For the sake of clarity, we keep the same notations as Chetty and Szeidl (2012). For instance, we denote M the outstanding mortgage balance, PV the current market value of the house (i.e., the property value), $HE = PV - M$ the home equity (i.e., the net housing wealth).

Chetty and Szeidl (2012) derive the main equation for optimal portfolio shares from a theoretical stylized two-period model. This equation, whose parameters are estimated by several econometric techniques (OLS, 2SLS, Tobit), is the following:

$$\text{stock share}_i = \alpha + \beta_1 \text{PV}_i + \beta_2 \text{HE}_i + \gamma X_i + \epsilon_i \tag{1}$$

where:

[1] A *département* is an administrative zone. There are 96 départements in France. Each of them has approximately the same geographical size (6,000 km2), but different populations.

- β_1 is the effect of property value holding fixed home equity wealth,

- β_2 is the effect of home equity wealth holding fixed property value,

- X_i is a vector of control variables representing other observable portfolio determinants.

The error term ϵ captures unobserved determinants of portfolio.

To estimate this equation, we use the same techniques as Chetty and Szeidl (2012). First, the above equation is estimated by ordinary least squares (OLS). However, the OLS parameter estimates for this equation may be biased since property value and home equity, denoted PV and HE respectively, are potentially endogenous. Then we use two-stage least squares (2SLS) techniques to circumvent this problem. More precisely, the two endogenous regressors are assumed to be affected by two instrumental variables, which generate exogenous variations in property value and home equity, while they do not affect the variable of interest, namely the stock share owned by the household. To replicate as closely as possible Chetty and Szeidl's methodology, our IVs are the average home price per square meter in the household's residence area (*département*) in the year in which portfolios are measured, i.e., 2009 Q4 ("date of the survey"), and the average home price per square meter in the household's residence area (*département*) in the year of the home purchase. The intuition for the identification strategy with these two IVs is summarized in Appendix A.

But the 2SLS (or IV) method ignores that many households (approximately 70% in the U. S. and the French samples) do not possess any stock. Holding stock involves indeed two decisions, namely participating or not in the stock market and assessing the stock amount to be held. Stock share is therefore a limited dependent variable, and 2SLS methods may be biased.

To improve the estimation method, we suggest two models which take into account the possible nullity of stock share. We first estimate a Tobit-1 model. In this model, the variables which determine the household's participation in the stock market are the same as the variables which determine the amount of stockholding. The instrumented Tobit-1 model is a three-equations model, whose specification is:

$$\begin{cases} PV = Z_1\gamma_1 + u_1 \\ HE = Z_2\gamma_2 + u_2 \\ \alpha^* = (C + \beta_1 PV + \beta_2 HE + \gamma X_1 + \epsilon) \times \mathbb{1}\{C + \beta_1 PV + \beta_2 HE + \gamma X_1 + \epsilon > 0\} \end{cases} \tag{2}$$

with

$$\begin{pmatrix} u_1 \\ u_2 \\ \epsilon \end{pmatrix} \sim \mathcal{N}\left\{0; \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_2^2 & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_3^2 \end{bmatrix}\right\}$$

In the last equation, α^* denotes the household's stock share (in percentage of the total liquid wealth) which may be equal to zero. The first two equations are instrumenting equations for the property value (PV) and the home equity (HE) endogenous variables. The vectors Z_1 and Z_2 include both the two IVs (namely, the average home price per square meter in the household's residence area in the year in which portfolios are measured, and the average home price per square meter in the same area in the year of the home purchase), as well as other exogenous covariates such as the number of children in the household, the household's earned income level, the age group and the education of the household head, indicator variables for the home surface, fixed effects for the household's residence area (*département*) and year dummies,

A drawback of the Tobit-1 model is that it assumes that variables which affect the extensive margin (i.e., the nullity of the stock share) are the same as those which determine the intensive margin (namely, the amount of the stock share). This assumption is relaxed in a generalized Tobit-2 model whose specification is:

$$\begin{cases} Y = \mathbb{1}\{\epsilon_2 > -Z_3\gamma_3\} \\ PV = Z_1\gamma_1 + u_1 \\ HE = Z_2\gamma_2 + u_2 \\ \alpha^* = Y \times (C + \beta_1 PV + \beta_2 HE + \gamma X_1 + \epsilon_1) \end{cases} \tag{3}$$

with

$$\begin{pmatrix} \epsilon_2 \\ u_1 \\ u_2 \\ \epsilon_1 \end{pmatrix} \sim \mathcal{N}\left\{0; \begin{bmatrix} 1 & \sigma_{12} & \sigma_{13} & \sigma_{14} \\ \sigma_{21} & \sigma_1^2 & \sigma_{23} & \sigma_{24} \\ \sigma_{31} & \sigma_{32} & \sigma_2^2 & \sigma_{34} \\ \sigma_{41} & \sigma_{42} & \sigma_{43} & \sigma_3^2 \end{bmatrix}\right\}$$

In this four-equations system, the first equation is the selection equation which determines whether or not the household holds stocks (i.e., whether or not the household participates in the stock market). For identifiability reasons, the vector Z_3 contains all covariates included in Z_1 and Z_2, but also two supplementary instrumental variables which are assumed to affect the household's participation in the stock market, but not the stock share level itself. These two instruments are the unemployment rate in the household's residence area (*départment*) and a dummy indicating whether the household inherited securities. When a person inherits securities or stocks, the cost of entry into the stock market is already paid (Peress, 2004). Then the heir/heiress has only to adjust his/her risk exposure. One can think therefore that inheritance affects participation in the stock market but not the stock share level. The unemployment rate is an indicator of the degree of employment risk in the *départment*. It is obviously more difficult to argue that the unemployment rate does not also affect the stock share level. We can only test for its validity as an IV by incorporating it into the list of regressors of the stock share equation, the inheritance dummy being still excluded from this list but included in the Z_3 vector. When running this exercise, we find that the estimated coefficient of the unemployment rate in the stock share equation is not statistically significant. A similar exercise has been done for the other instrument (i.e., the inheritance dummy), whose estimated coefficient is also statistically non-significant in the stock share equation.[2]

Tobit-1 and Tobit-2 models are estimated by using the maximum likelihood technique.

3 Data

This section presents the two data sources used in our paper. We first explain the construction of the house price indices calculated each year in each residence area (*département*). We then discuss the portfolio data obtained from the 2010 *Patrimoine* survey collected by INSEE (Institut National de la Statistique et des Etudes Economiques, Paris) at the household level.

We use the Notaires-INSEE house price indices which are the result of a collaboration between the French notaries[3], who collect the data and do the computation, and INSEE (i.e., the French statistical agency) that provides the methodology. These indices are assumed to take into account changes in the quality of houses. Because all indices are standardized to be equal to 100 in 2000, we need also to introduce geographic variability: for that purpose, we use home prices per square meter in each *département* in 2000. House prices per square meter at the *département* level are collected by the *Chambre des Notaires*. They refer to the average price per square meter of all transactions of existing single-family homes which are registered in a given year. Our data present some limitation since the *Chambre des Notaires de Paris* began to collect home prices in the database *Bien* in 1992, while the *Notaires de France* began to collect home prices for the rest of France in the database *Perval* in 1994. We therefore exclude from our analysis households who bought their home before 1994.

For obtaining statistical observations on portfolios, we use the 2010 *Patrimoine* survey collected by INSEE. This survey is a cross-sectional survey conducted by the French statistical

[2] In the stock share equation, the estimated coefficients are equal to -0.4364 (t-statistic -1.4178) for the unemployment rate and to 0.1478 (t-statistic 0.0826) for the inheritance dummy. With these two further instruments, our Tobit-2 is indeed over-identified. But this over-identification increases the statistical power of the estimates of interest parameters.

[3] Solicitor is the English equivalent for the French word *notaire*, or notary. Countries with a legal system based on Napoleonic law utilise notaries public to perform certain functions that solicitors carry out in English law.

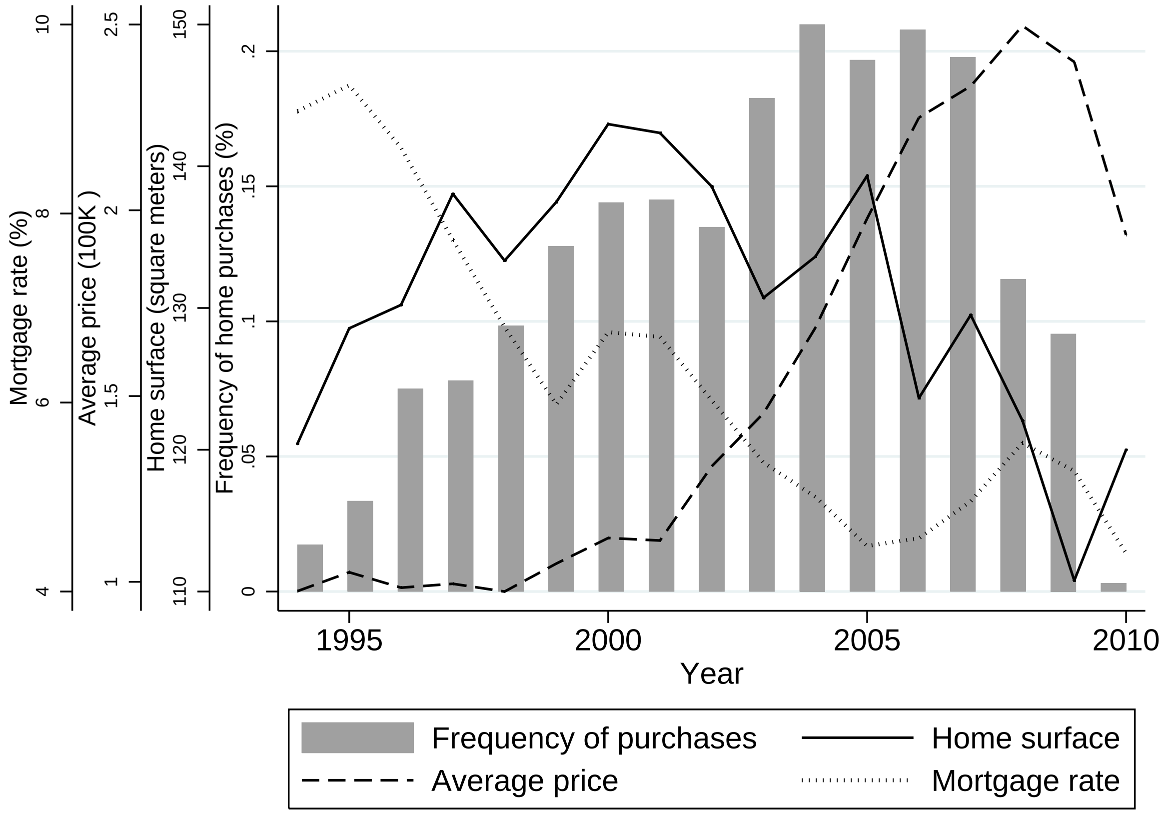
agency every 6 years. We use the latest available survey (2010), which was run on a nationally representative sample of 15,000 households, for whom detailed information on personal holdings is available. We select the homeowners who have still a positive mortgage debt at the date of the survey because if the household has no more debt, property value and home equity are equal and the model is no more identifiable. We are then left with $2,500$ households. Then we select households who bought their current home after 1994 in order to match their portfolios with the corresponding price indices. This last restriction gives a final sample of $2,034$ observations when we do not use the home surface as a regressor, and a sample of $2,014$ observations when we use it (because this information is missing for 20 households). The survey provides also data on the current and initial home property value, the current and initial mortgage debt, the home surface, the household's residence area, etc. But it also contains detailed information on the socioeconomic and demographic characteristics of the household, on the household's income, and on the amount and the composition of the household's financial portfolio.

Table 1 reports summary statistics for our sample. Homeowners own houses that are worth approximately 275,000€ on average in 2010. The average amount of home equity is 190,000€ and the average outstanding mortgage is 84,000€. On average, the household head is 44 years old and has lived in his/her current home for 7 years. Mean total wealth (which includes liquid wealth, home equity and other illiquid assets) is 421,272€. Liquid wealth is defined as in the study by Chetty and Szeidl (2012): it equals the sum of assets held in stocks, bonds, checking and saving accounts. In our sample, the average liquid wealth is 83,000€. Households hold on average approximately 6% of their liquid wealth in the form of stocks, but this small fraction held in stocks reflects the fact that, in our sample, only 29% of the households hold stock. The fraction is much higher, namely 19%, if we consider only those who participate in the stock market.

In Figure 3.1, we report variations over the years 1994-2010 in the values of the average national mortgage rate (provided by *Banque de France*, Paris), of the average price of homes bought by households observed in our sample, of their average surface, and of the sample frequency of households who bought their home after 1994 and who have still a positive mortgage debt at the date of the survey. From 1994 to 2010, the average price of homes observed in our sample has evolved as the aggregate average price: it has strongly increased between 2002 and 2007, and has slightly decreased after 2008. The average home surface has increased between 1994 and 2000, and then decreased over the last decade, correlatively with the increase in the average price of homes observed over the same period. The average mortgage rate has continuously decreased over the observation period, going approximately from 9% to 4%. The annual frequency of home purchases observed in our sample is not uniform. Because of our selection criteria (which correspond to a stock sampling scheme), it is lower at the beginning of our observation period, and then increasing up to 2007. It decreases at the end of the period (2008-2009) because of the impact of the financial crisis.

We now explain how we compute the stock share of financial portfolio from the survey (*Patrimoine*). In France shares can be held in different ways. A stockholder can hold shares directly, through a share savings plan (PEA) in order to benefit from advantageous tax credits, through share investment, mutual fund (FCP or SICAV) [4] or through securities accounts. We sum the declared amounts for these investment schemes and compute the stock share as the ratio of this sum to the household's total financial wealth.

Figure 3.1: Annual average values of the mortgage rate, the home price, the home surface, and the frequency of home purchases (1994-2010)



Source: Banque de France, INSEE Survey.

4 Estimates

In columns 1 and 2 of Table 2, we report OLS parameter estimates of equation (1), namely those of a simple OLS regression of the stock share on home equity and property value in presence of other covariates. In the first column we control for the household's residence area, the household head's age, and the year of home purchase. In the second column, we control also

[4]Among such mutual funds, we keep only those which are defined as "share managing funds" by the French *Autorité des Marchés Financiers*

for supplementary covariates, such as the number of children in the household, the household's earned income level, the education of the household head, and an indicator variable for the home surface. The OLS estimates imply that an increase in the property value is strongly positively associated with the stock share of liquid wealth, while the estimated coefficient of home equity is negative but non-significantly different from zero. Incorporating more covariates reduces the magnitude of the coefficient associated with property value, but the estimated parameter remains positive. These estimates are in contradiction with theoretical predictions. But they cannot be interpreted as causal effects: because of the endogeneity of the housing choice, OLS should indeed give biased estimates of the effect of housing on stock shares. [5]

To compare our results with those obtained by Chetty and Seizdl (2012), we then estimate parameters of equation (1) by two stage least squares (2SLS).

Table 3 reports estimated parameters of auxiliary regressions for two distinct sets of instruments. In the first three columns, we regress property value, home equity and mortgage debt on the two main instruments, namely the local house price per square meter at the date of the purchase and the local house price per square meter at the date of the survey. Columns 1 and 2 show that the current house price has a positive and highly statistically significant effect both on the property value and on the home equity. For a given value of the house price index at the survey date, a higher house price at the date of purchase has a statistically significant positive effect on property value (column 1) but a statistically significant negative effect on home equity (column 2). Once combined, these two opposite effects imply that a higher house price at the time of purchase corresponds to a larger mortgage (see column 3). However, a higher current price predicts a smaller mortgage (but to a smaller extent).

We find therefore the same main effects as in Chetty and Szeidl's study except for two estimated coefficients. First, Chetty and Szeidl find a positive effect of the house price index at the survey date on mortgage debt. They explain this positive sign by the possibility of refinancing in the US. This possibility being virtually nonexistent in France (see Mésonnier, 2004), this may explain why we find a negative effect. Second, they find that, for a given level of the current price, a higher house price at the time of purchase predicts a slightly lower current property value: the corresponding estimated coefficient is negative, while our estimate is positive (see column 1, Table 3). The negative sign they obtain reflects that households purchase smaller houses if they buy when prices are relatively high. We do not find this negative sign in our data. But when we incorporate interactions between the house price at the time of purchase and the house surface (grouped in four categories), We find a negative sign for the small surfaces under 80 square meters (see the last three columns of Table 3). Households who change their behavior when house prices are high are indeed financially constrained. But these constrained households are the poorest ones or the first time buyers, i.e., those who buy small houses. These results

[5]The positive correlation between stock share and property value is not surprising since a household characterized by a higher property value is likely to be wealthier and to hold more stocks (see, for instance, Calvet, Campbell and Sodini 2008 who find evidence for the positive link between wealth and risky portfolio).

show that the two instruments are powerful determinants of property value and home equity, even conditional on a rich set of covariates.

Table 4 reports parameter estimates of the stock share equation in the case where IVs are non-interacted with the house surface. In that exercise we use the same econometric specifications as in Chetty and Szeidl's study (2012). Columns 1 and 2 report the 2SLS estimated parameters of the regression of the stock share on instrumented property value and home equity when two distinct sets of covariates are considered. In column 1 we estimate the model with a covariate vector including the year of purchase, the age of the household head, and residential area fixed effects. The point estimate of the property value coefficient implies that a 10,000€ increase in property value reduces stock share of liquid wealth by 1.97 percentage points, when home equity is held fixed. The point estimate of the home equity coefficient implies that a 10,000€ increase in home equity increases stock share of liquid wealth by 5.59 percentage points, when property value is held fixed. Adding other covariates such as the number of children in the household, the household's earned income level, the education of the household head, and an indicator variable for the home surface does not change the outcomes (see column 2, Table 4).

For instance, the point estimate of the property value coefficient reported in column 2 (Table 4) implies that a 10,000€ increase in a household's mortgage debt reduces his stock share of liquid wealth by 0.32 percentage points (266€). Given a mean stock share in the analysis sample of 5.59%, this is equivalent to a 5.7% reduction in the stock share of liquid wealth, which is quite similar to the corresponding value (5.5%) obtained by Chetty and Szeidl (2012) with a 2SLS procedure. The elasticity of the stock share of liquid wealth with respect to mortgage debt is approximately -0.48 at the sample mean mortgage debt of 84,000€. Once again, our estimated elasticity is close to the one (-0.3) estimated by Chetty and Szeidl (2012).

The estimate of the home equity coefficient in column 2 (Table 4) implies that a 10,000€ increase in home equity raises the stock share by 0.66 percentage point (11.8%) when total property value is held fixed. The mean home equity in the sample is approximately 190,800€, implying an elasticity of stock share of liquid wealth with respect to home equity wealth of approximately 2.25. This estimated elasticity is much higher than the one (0.4) estimated by Chetty and Szeidl (2012). This gap is partly due to the difference between the mean values of home equity in the two samples ($72,000 in the US sample, 190,000€ in the French sample).

Columns (3-5) report the results of some robustness exercises, conducted with other specifications or sample definitions. In column 3, we regress the stock share on the logarithms of the instrumented property value and home equity variables, and the full set of covariates. Column 4 reports estimates when instrumented variables are expressed as shares of the household's liquid wealth. In other terms, we only replace the property value and the home equity by the ratio of each variable to liquid wealth. We follow Chetty and Szeidl (2012) by excluding the observations with a ratio above 20. In column 5, we limit our sample to those households who have more than 150,000€ of total wealth. These three robustness checks show that results are generally quite stable. In spite of the instability of some specifications (logarithms of instrumented variables, shares of liquid wealth), the estimates are consistent with the main specification and the corresponding coefficients have the expected signs.

In column 6 of Table 4, we estimate a linear regression model for the extensive margin, as in Chetty and Szeidl'study (2012). More precisely, we regress a dummy for participation in the stock market on the instrumented variables. In other terms, column 6 replicates column 2, replacing the stock share with a dummy variable indicating whether the household owns stocks or not. When home equity is held fixed, a 10,000€ increase in the household's property value is estimated to reduce the probability of owning stocks by 1.7 percentage points, the proportion of households owning stocks being equal to 29% in our sample. When property value is held fixed, a 10,000€ decrease in home equity is estimated to increase the probability of owning stocks by 3.2 percentage points.

To conclude with the 2SLS estimations, we find the same qualitative effects as in Chetty and Szeidl's study (2012): the coefficient of the home equity variable is positive, the one associated with property value is negative. More precisely, when home equity is held fixed, a 10,000€ increase in property value (that can be interpreted as a 10,000€ increase in mortgage debt because property value is the sum of home equity and mortgage debt) reduces stock share of liquid wealth by 0.32 percentage point. On the contrary, when property value is held fixed, a 10,000€ increase in home equity (that can be interpreted as a 10,000€ decrease in mortgage debt for the same reason) raises stock share of liquid wealth by 0.66 percentage point.

But quantitatively, results obtained with French data are different from results obtained with US data. With US data, the coefficients of the property value effect and of the home equity effect are of the same order of magnitude (around 0.7 percentage point for the main specification). However, with French data, the coefficient of the home equity effect is found to be roughly twice the coefficient of the property value effect. In France the wealth effect of having more home equity dominates the effect of owning a more expensive house (which is the housing risk effect). It follows that the demand for risky assets covaries with current house price fluctuations (because price fluctuations affect both wealth and property value simultaneously).

In Table 5, we report the estimated coefficients of the same estimations as those of Table 4 but the endogenous regressors are now depending on the interacted instruments, which are the interactions between the average house price per square meter in the household's residence area at the date of purchase and the home surface, the other IV being still the non-interacted average house price per square meter in the household's residence area at the survey date. These results are very close to those obtained with the non-interacted IVs. They illustrate the robustness of our estimates.

However, in the previous estimations, nonnegativity of the stock share is ignored and consequently estimates could be biased. Table 6 reports the estimations obtained for the Tobit-1 and the Tobit-2 estimations with both sets of instruments. With the Tobit-1 specification, the coefficients of the interest equation are still highly statistically significant and are larger than those of the 2SLS regressions (columns 1 and 2, Table 6). A 10,000€ increase in property value (home equity being fixed) is estimated to reduce the stock share of liquid wealth by 0.7 percentage point when IVs are non-interacted, and by 0.95 percentage point when IVs are interacted. A 10,000€ increase in home equity (property value being fixed) is estimated to increase stock share of liquid wealth by 1.65 percentage points when IVs are non-interacted, and by 1.88 percentage points when IVs are interacted.

Columns (3-6) in Table 6 report maximum likelihood estimates of the Tobit-2 model parameters. Results are consistent with the previous estimates. Nevertheless coefficients of the interest equation are lower than those of the Tobit-1 model. A 10,000€ increase in property value is estimated to reduce stock share of liquid wealth by 0.07 percentage point when IVs are non-interacted, and by 0.43 percentage point when IVs are interacted. The implied elasticity of the stock share of liquid wealth with respect to mortgage debt is approximately -0.10 at the sample mean mortgage debt of 84,000€ when IVs are non-interacted, and -0.64 when IVs are interacted. A 10,000€ increase in home equity is estimated to increase stock share of liquid wealth by 0.62 percentage point when IVs are non-interacted, and by 1.02 percentage point when IVs are interacted. The implied elasticity of the stock share of liquid wealth with respect to home equity wealth is approximately +2.12 at the sample mean home equity of 190,800€ when IVs are non-interacted, and +3.48 when IVs are interacted. With the Tobit-2 specifications, estimated elasticities of the stock share of liquid wealth are substantially increased when IVs are interacted. When IVs are non-interacted, they compare with those estimated by using the corresponding 2SLS model.

The estimated parameters associated with the two instruments added in the participation equation, i.e., the unemployment rate and the securities inheritance dummy, are significant and have the expected signs: a higher unemployment rate predicts a lower probability to hold stock and inheriting securities increases the probability to participate in the stock market (see columns 4 and 6, Table 6). Besides, estimated coefficients of home equity and property value have also the expected signs: a 10,000€ increase in the household's property value is estimated to reduce the probability of owning stocks by 1.8 percentage points (this compares with -1.7 percentage points for the linear model), while a 10,000€ decrease in home equity is estimated to increase the probability of owning stocks by 3.0 percentage points (this compares with +3.2 percentage points for the linear model).

5 Concluding remarks

Using French data, we get results that are close to those obtained by Chetty and Szeidl (2012). We find the same qualitative effects but some quantitative discrepancies. All our estimates of the home equity effects are roughly twice the estimated values of the property value effects. We also provide estimations of parameters of the extensive margin equation which takes into account the non-negativity of the stock share.

To conclude, we propose some explanations for the quantitative differences between our results and those obtained by Chetty and Szeidl (2012).

To do so, we exploit the theoretical predictions of the housing and portfolio choice model built by Cocco (2005), then used and generalized by Chetty and Szeidl (2012). In their study, Chetty and Szeidl compute the optimal stock share of the household's portfolio for different quantities of property value and home equity, and for different ranges of model parameters. For instance, when the household has a home equity of 72,000$ and a property value of 125,000$, which are the average values of these variables in their sample, they find an optimal stock share of 66%. A 10,000$ increase in home equity (property value being fixed) corresponds to an optimal stock share of 71.9%, i.e., an increase of 8.9% in stock share and a 10,000$ increase in property value (home equity being fixed) corresponds to an optimal stock share of 59.7%, i.e., a decrease of 9.6% in stock share.[6]

But they also generalize the model by incorporating three other features: fixed adjustment costs, which permit households to move at any time by paying a cost, multi-period dynamics with persistent uncertainty, or labor income risk. By using the simulation results reported in Chetty and Szeidl's article, we compute the magnitude of the property value effect and the magnitude of the home equity effect on stockholding for these four different models, namely the baseline model which does not incorporate these three features and the three models incorporating each of the three features separately. Our results are based on the parameter values chosen by Chetty and Szeidl. The correlation coefficient between housing market and stock market is set at 0.1, which is close to our estimate of this coefficient for France over the period 1994-2011. The probability that the household does not move is set at 0.55, which is the value estimated by Cocco (2005). The annual risk free return is set at 0.02, the annual mortgage rate at 0.04 and the coefficient of relative risk aversion at 10. These values are compatible with the French case.

In Table 7, we report the coefficients of the property value effect and of the home equity effect. We observe that for three of the five chosen specifications, the two effects are of the same order of magnitude. But for the model with fixed adjustment costs, the effect of property value is lower (in absolute terms) than the effect of home equity. When λ is equal to 0.1, i.e., the

[6] See Table 1 in Chetty and Szeidl (2012).

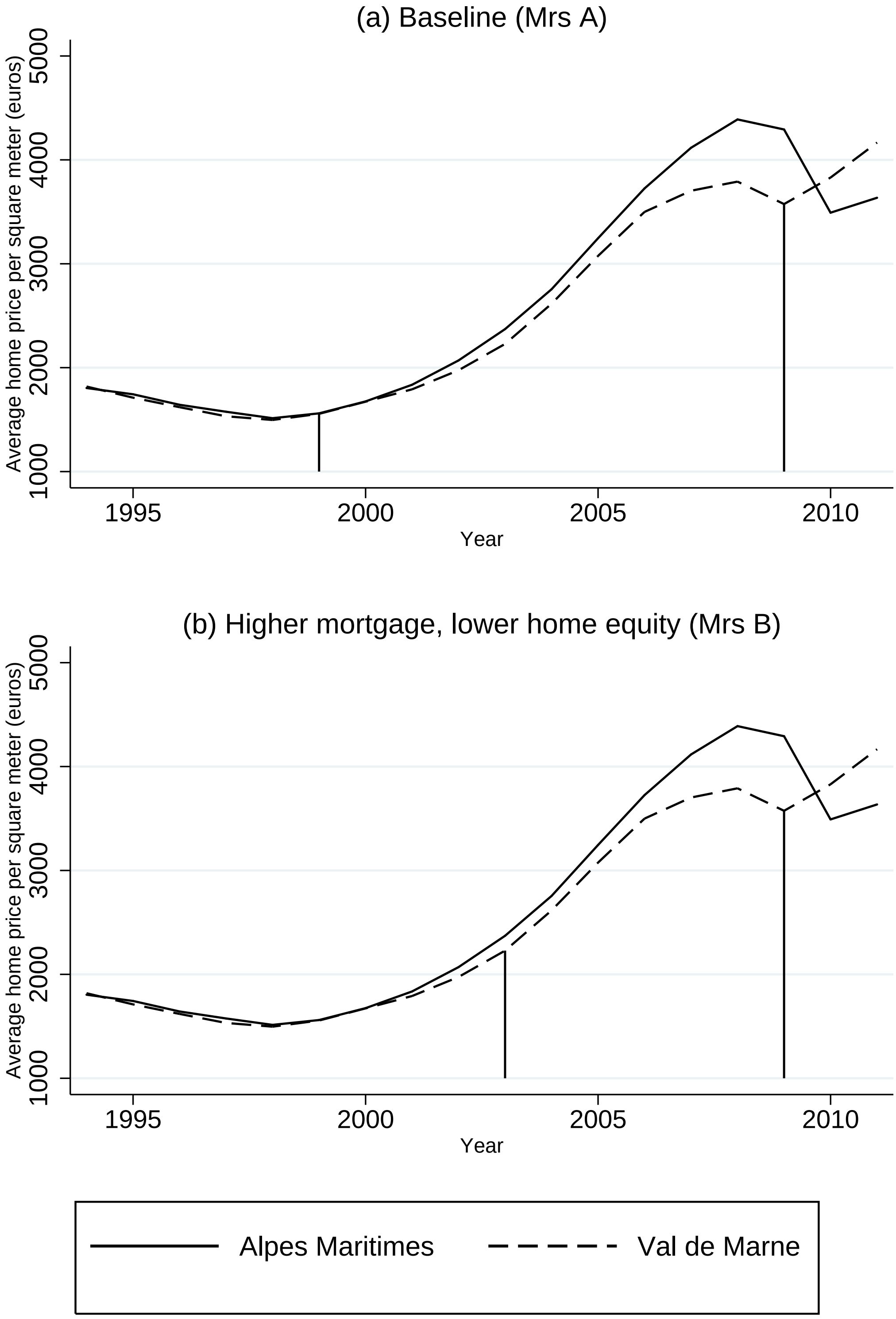
share of property value people must pay if they move is 0.1, the property value effect is around 1.6 times smaller than the home equity effect. When λ is equal to 0.2, the property value effect is around 17 times smaller than the home equity effect.

According to several previous studies, it is reasonable to think that fixed adjustment costs are higher in France than in the US. These costs include a number of different types of costs and fees, such as transfer taxes (e.g. stamp duties, acquisition taxes, etc.), fees incurred when registering the property in the land registry, notary or other legal fees, and real estate agency fees. Andrews *et al.* (2012) calculate that housing transaction costs represent 10.65% of the property value in France, and 4.25% of the property value in the US. In another study, Laferrère and Leblanc (2007) estimate the average transaction costs at around 14% for France, compared with 10% in the USA. These different levels of fixed adjustment costs in housing could therefore explain the quantitative discrepancy of the effect of housing on portfolio choice between France and the US.

A Appendix

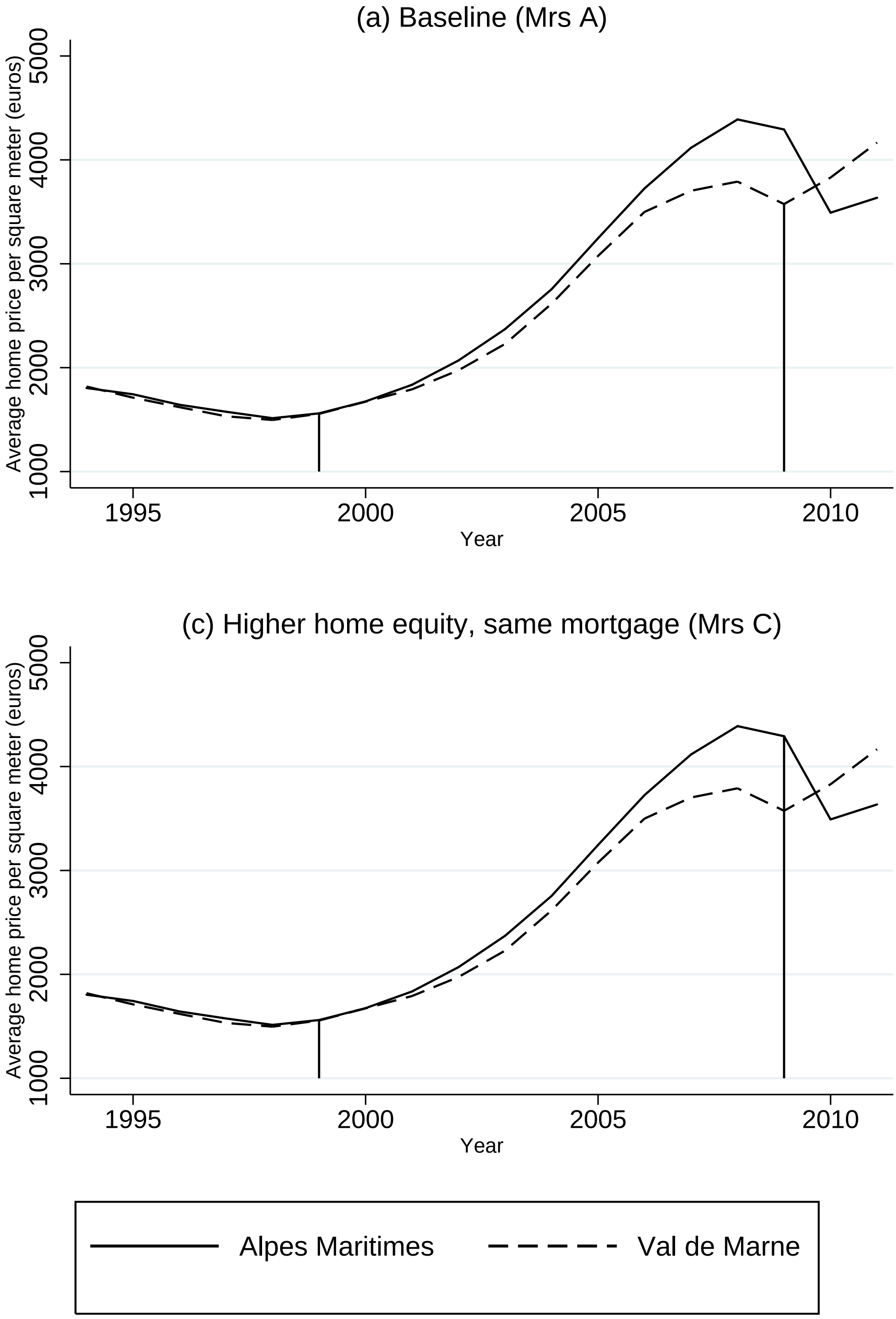
Consider a hypothetical experiment involving a set of individuals who buy identical houses and only pay interest on their mortgage (debt outstanding does not change over time). As a baseline, consider Mrs A who buys a house in Val de Marne in 1999. Consider now Mrs B who buys the same house but in 2003. We observe their portfolio in 2010 (date of the INSEE survey *"Patrimoine"*). Mrs A and Mrs B have the same current property value but Mrs B has less home equity than Mrs A (see Figure A.1). Now consider Mrs C who buys an equivalent house in Alpes Maritimes in 1999. At the date of the survey, we observe that Mrs A and Mrs C have the same mortgage debt, but Mrs C has a higher property value and, consequently, she has a higher home equity (see Figure A.2). Thus we can separately identify the causal effect of mortgages and home equity on portfolios.

Figure A.1: Intuition for instruments



Source: Indices Notaires, INSEE (Paris).

Figure A.2: Intuition for instruments



Source: Indices Notaires, INSEE (Paris).

Table 1: Summary Statistics

	Mean (1)	Median (2)	Standard Deviation (3)
Demographics:			
Age of the household head (years)	43.75	43	9.81
Years of education of the household head	12.97	12	3.00
Number of children in the household	1.38	1	1.18
Household's earned income (€)	41,091	33,000	24,736
Housing:			
Property value (€)	274,337	225,451	202,047
Mortgage (€)	83,537	62,796	82,943
Home tenure (years)	7.04	7	3.75
Wealth			
Total wealth (€)	421,272	274,932	555,451
Liquid wealth (€)	83,399	19,187	337,085
Home equity (€)	190,800	149,945	175,997
Equity in other real estate (€)	82,239	0	254,967
Life insurance (€)	52,734	8,800	161,387
Portfolio Allocation			
Percent of households holding stock	29.45%	0%	45.59%
Stock share (% of liquid wealth)	5.59%	0%	14.86%
Stock share (% of liquid wealth) for participants	19.01%	10.32%	22.27%
Number of Observations		2034	

Notes: These statistics correspond to households who are observed in the 2010 *Patrimoine* survey and who purchased their principal residence after 1994 and are still repaying mortgage debt in 2010. Data come from declarative amounts.

Table 2: OLS regressions

Dependent variable	Stock share	
	(1)	(2)
	(%)	(%)
Property value (x € 100K)	1.761***	1.327***
	(0.4185)	(0.4215)
Home Equity (x € 100K)	-0.533	-0.531
	(0.4861)	(0.4843)
Geographic area, years	x	x
Demographics		x
Income		x
Observations	2,231	2,231

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: In the first column, we control for the household's residence area, the household head's age, and the year of home purchase. In the second column, we control also for supplementary covariates, such as the number of children in the household, the household's earned income level, the education of the household head, and an indicator variable for the home surface.

Table 3: Estimated parameters of auxiliary regressions (First stage of 2SLS)

Research Design: Variation in Local Home Prices

Dependent Variable	Non-interacted IVs			Interacted IVs		
	Prop Val (×€100K) (1)	Home Equity (×€100K) (2)	Mortgage (×€100K) (3)	Prop Val (×€100K) (4)	Home Equity (×€100K) (5)	Mortgage (×€100K) (6)
House price index	0.769***	0.955***	-0.212***	0.852***	1.003***	-0.180***
at the date of survey (×€1000)	(0.0547)	(0.0489)	(0.0259)	(0.0507)	(0.0470)	(0.0253)
House price index	0.321***	-0.281***	0.634***			
at the date of purchase (×€1000)	(0.0574)	(0.0513)	(0.0272)			
House price index at the date of purchase				-0.429***	-0.791***	0.387***
for surface ≤ 35 (×€1000)				(0.0788)	(0.0732)	(0.0393)
House price index at the date of purchase				-0.110*	-0.570***	0.488***
for $35 <$ surface ≤ 80 (×€1000)				(0.0628)	(0.0582)	(0.0313)
House price index at the date of purchase				0.239***	-0.341***	0.613***
for $80 <$ surface ≤ 120 (×€1000)				(0.0584)	(0.0543)	(0.0292)
House price index at the date of purchase				0.885***	0.121**	0.802***
for surface > 120 (×€1000)				(0.0606)	(0.0562)	(0.0302)
Residential area, years, age	x	x	x	x	x	x
Other controls	x	x	x	x	x	x
Observations	2,034	2,034	2,034	2,014	2,014	2,014
Adjusted R-squared	0.546	0.515	0.386	0.609	0.542	0.426
Fisher test of joint nullity	F(2,1997)	F(2,1999)	F(2,1999)	F(5,1973)	F(5,1976)	F(5,1976)
	343.09	263.09	345.21	241.96	158.75	178.17
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Partial R2	0.2557	0.2084	0.2567	0.3876	0.2973	0.3094

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: In all specifications, we control for the household's residence area, the household head's age, the year of home purchase, the number of children in the household, the household's earned income level, the education of the household head, and also for the home surface with an indicator variable in the first three specifications.

Table 4: Estimated parameters of the stock share equation with non-interacted IVs (2SLS)

Research Design: Variation in Local Home Prices

Dependent Variable	Non-interacted IVs					
	Stock Share					Stockholder
			Log	Shares	High Wealth	
	(%)	(%)	(%)	(%)	(%)	(1-0)
	(1)	(2)	(3)	(4)	(5)	(6)
Property value(×€100K)	-1.966***	-3.186***			-5.078***	-0.172***
	(0.924)	(0.976)			(1.356)	(0.0284)
Home equity(×€100K)	5.593***	6.604***			8.942***	0.317***
	(1.121)	(1.151)			(1.595)	(0.0349)
Log property value			-1.818			
			(2.619)			
Log home equity			6.550***			
			(1.955)			
Property val/liq wealth				-1.540***		
				(0.240)		
Home eq/liq wealth				0.846**		
				(0.358)		
Residential area, years, age	x	x	x	x	x	x
Other controls		x	x	x	x	x
Observations	2,034	2,034	2,034	1,492	1,237	2,034
Adjusted R-squared	0.083	0.097	0.073	0.040	0.099	0.157
Fisher test of joint nullity	F(2,2015)	F(2,2012)	F(2,2012)	F(2,1471)	F(2,1215)	F(2,1996)
	83.11	63.99	36.85	24.28	37.84	72.38
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: In all specifications, we control for the household's residence area, the household head's age, and the year of home purchase. In the last five specifications, we control also for the number of children in the household, the household's earned income level, the education of the household head, and the home surface.

Table 5: Estimated parameters of the stock share equation with interacted IVs (2SLS)

Research Design: Variation in Local Home Prices

	Interacted IVs					
Dependent Variable	Stock Share					Stockholder
			Log	Shares	High Wealth	
	(%)	(%)	(%)	(%)	(%)	(1-0)
	(1)	(2)	(3)	(4)	(5)	(6)
Property value(×€100K)	-1.604	-2.339**			-4.012***	-0.077**
	(1.177)	(1.008)			(1.368)	(3.012)
Home equity(×€100K)	4.875***	5.174***			7.168***	0.165***
	(1.518)	(1.225)			(1.663)	(3.894)
Log property value			-2.679**			
			(1.184)			
Log home equity			5.401***			
			(1.435)			
Property val/liq wealth				-1.434***		
				(0.237)		
Home eq/liq wealth				0.752**		
				(0.358)		
Residential area, years, age	x	x	x	x	x	x
Other controls		x	x	x	x	x
Observations	2,014	2,014	2,014	1,492	1,237	2,014
Adjusted R-squared	0.064	0.079	0.086	0.037	0.080	0.115
Fisher test of joint nullity	F(2,1992)	F(2,1985)	F(2,1985)	F(2,1465)	F(2,1215)	F(2,1973)
	67.64	17.81	18.79	17.79	36.57	76.21
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: In all specifications, we control for the household's residence area, the household head's age, and the year of home purchase. In the last five specifications, we control also for the number of children in the household, the household's earned income level, the education of the household head, and the home surface.

Table 6: Estimated parameters of Tobit models

	Tobit 1		Tobit 2			
	Non-interacted IVs	Interacted IVs	Non-interacted IVs		Interacted IVs	
Dependent Variable	Stock Share (%) (1)	Stock Share (%) (2)	Stock Share (%) (3)	Stockholder (1-0) (4)	Stock Share (%) (5)	Stockholder (1-0) (6)
Property value(×€100K)	-7.016***	-9.528***	-0.6719*	-0.0779***	-4.2559***	-0.175***
	(3.261)	(0.0313)	(0.4512)	(0.0505)	(1.8659)	(0.0794)
Home equity(×€100K)	16.511***	18.838***	6.2283***	0.2098***	10.1902***	0.297***
	(3.841)	(0.0379)	(1.7760)	(0.0699)	(2.4437)	(0.1025)
Unemployment rate				-0.0428***		-0.0393**
				(0.0173)		(0.0201)
Securities Inheritance				0.3337***		0.3926***
				(0.1332)		(0.1349)
Geographic area, years, age	x	x	x	x	x	x
Other controls	x	x	x	x	x	x
Log likelihood	8788.05	8535.92	8978.756		8409.84	
Wald test of joint nullity	$\chi^2(2)$	$\chi^2(2)$	$\chi^2(2)$	$\chi^2(4)$	$\chi^2(2)$	$\chi^2(4)$
	108.1	113.2	184.9	57.1,	113.3	38.4
Prob > χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	2,034	2,014	2,034		2,014	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: In all specifications, we control for the household's residence area, the household head's age, and the year of home purchase, the number of children in the household, the household's earned income level, the education of the household head, and the home surface.

Table 7: Comparison of simulation results

	Baseline model	Fixed adjustment costs $\lambda = 0.2$	$\lambda = 0.1$	Persistent uncertainty	Labor income risk
Effect of property value	−9.55%	−0.51%	−3.50%	−33.10%	−14.55%
Effect of home equity	8.94%	8.64%	5.80%	27.94%	14.55%

Notes: The effect of property value is the effect of an increase of 10,000$ in the average property value observed in the sample used by Chetty and Szeidl (125,000$), the effect of home equity is the effect of an increase of 10,000$ in the average home equity observed in their sample (72,000$), λ is the share of home value that must be paid as a fixed cost when moving.

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